US006866740B2

(12) **United States Patent**
Vaders

(10) **Patent No.: US 6,866,740 B2**
(45) **Date of Patent: Mar. 15, 2005**

(54) **METHOD OF MANUFACTURING CONTOURED CONSOLIDATED CELLULOSIC PANELS WITH VARIABLE BASIS WEIGHT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 261 days.

(21) Appl. No.: **09/996,206**

(22) Filed: **Nov. 28, 2001**

(65) **Prior Publication Data**

US 2003/0099812 A1 May 29, 2003

(51) **Int. Cl.**[7] **B27N 3/10**; B27N 3/20

(52) **U.S. Cl.** **156/267**; 156/245; 156/296; 156/580; 156/581; 156/583.1; 264/109

(58) **Field of Search** 156/62.2, 267, 156/245, 296, 580, 581, 583.1, 583.5; 264/109; 425/83.1, 371

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(57) **ABSTRACT**

A method of manufacturing a contoured, consolidated cellulosic article, with variable basis weight, is disclosed. The method employs a former to create a mat having a substantially uniform thickness which is pre-pressed to retain its shape. The pre-pressed mat is then machined along at least one surface to result in a desirable contour. The contoured mat is then consolidated within a secondary press. The secondary press preferably includes platens shaped complimentarily to the surfaces of the mat.

19 Claims, 4 Drawing Sheets

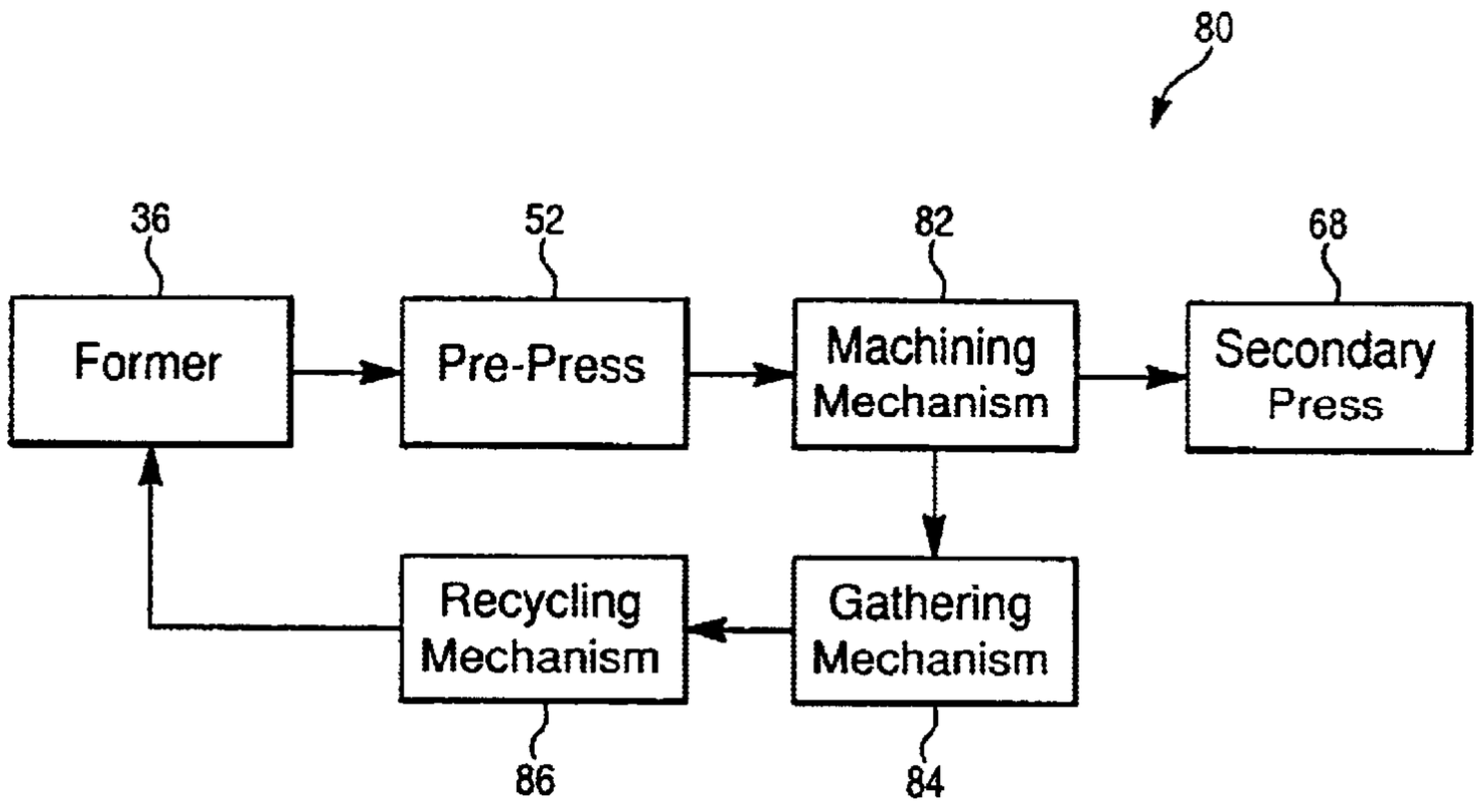


Fig. 1

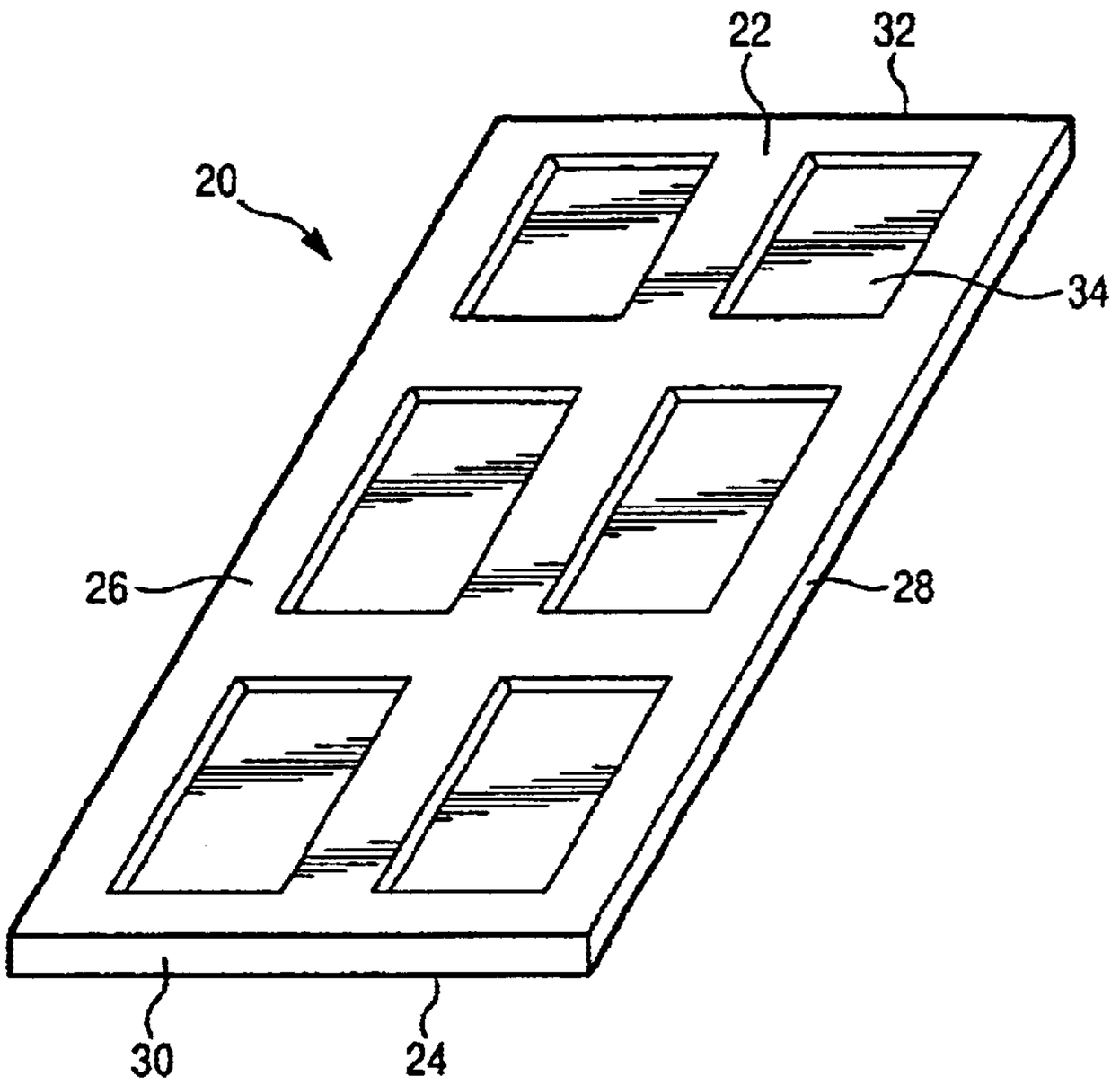


Fig. 2

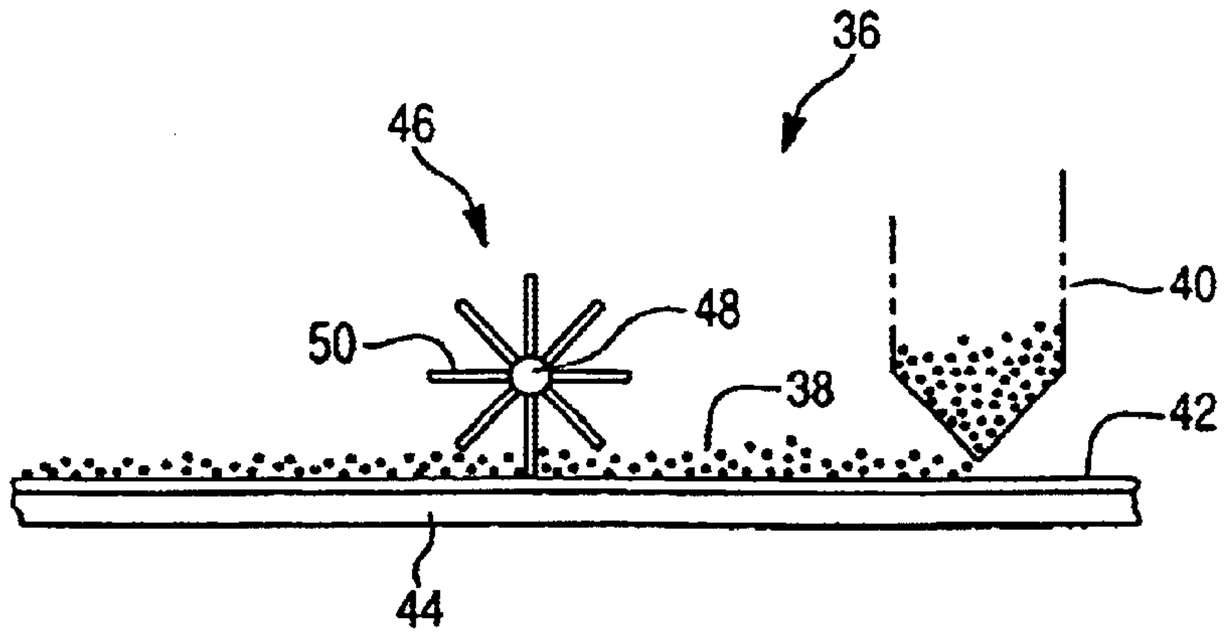


Fig. 3

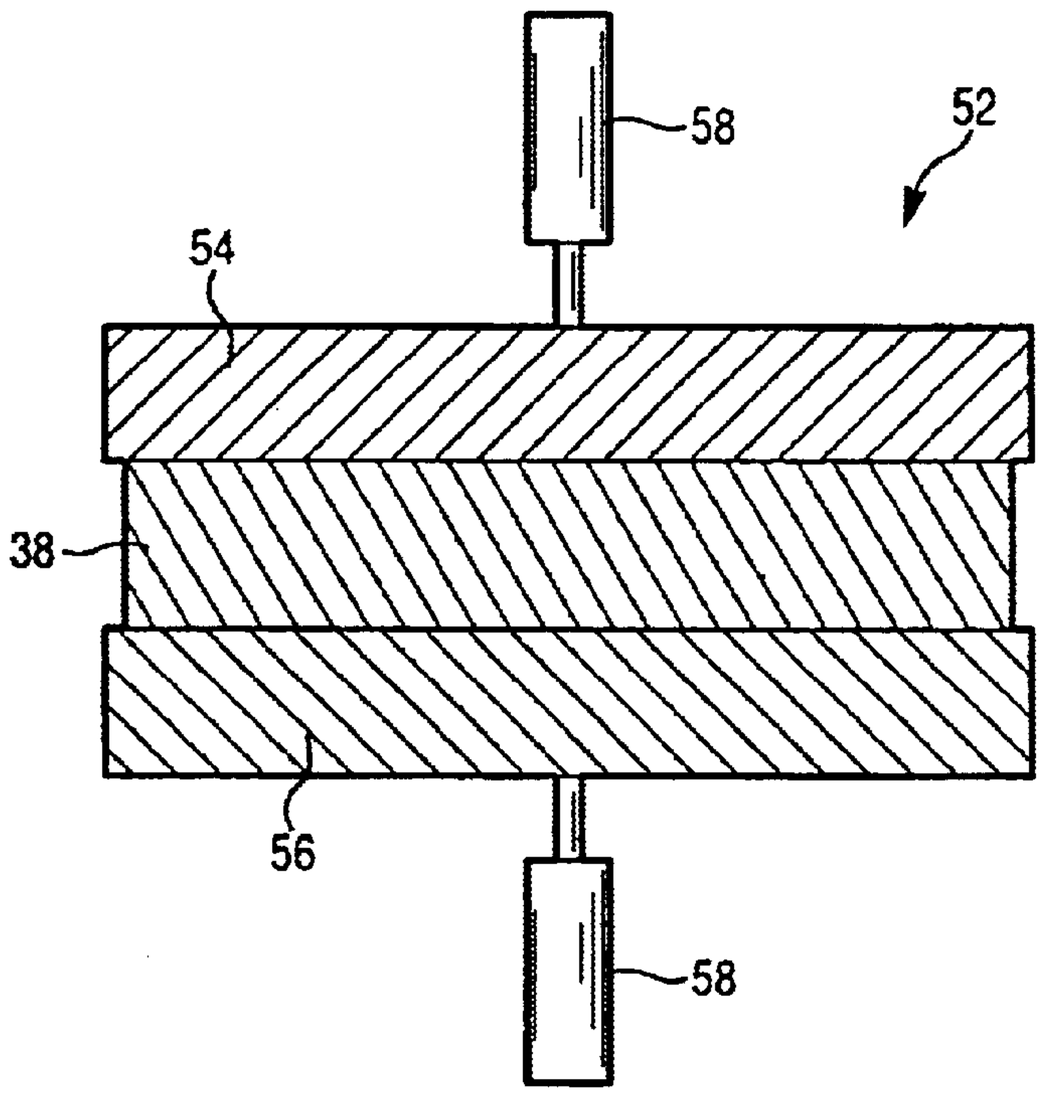


Fig. 4

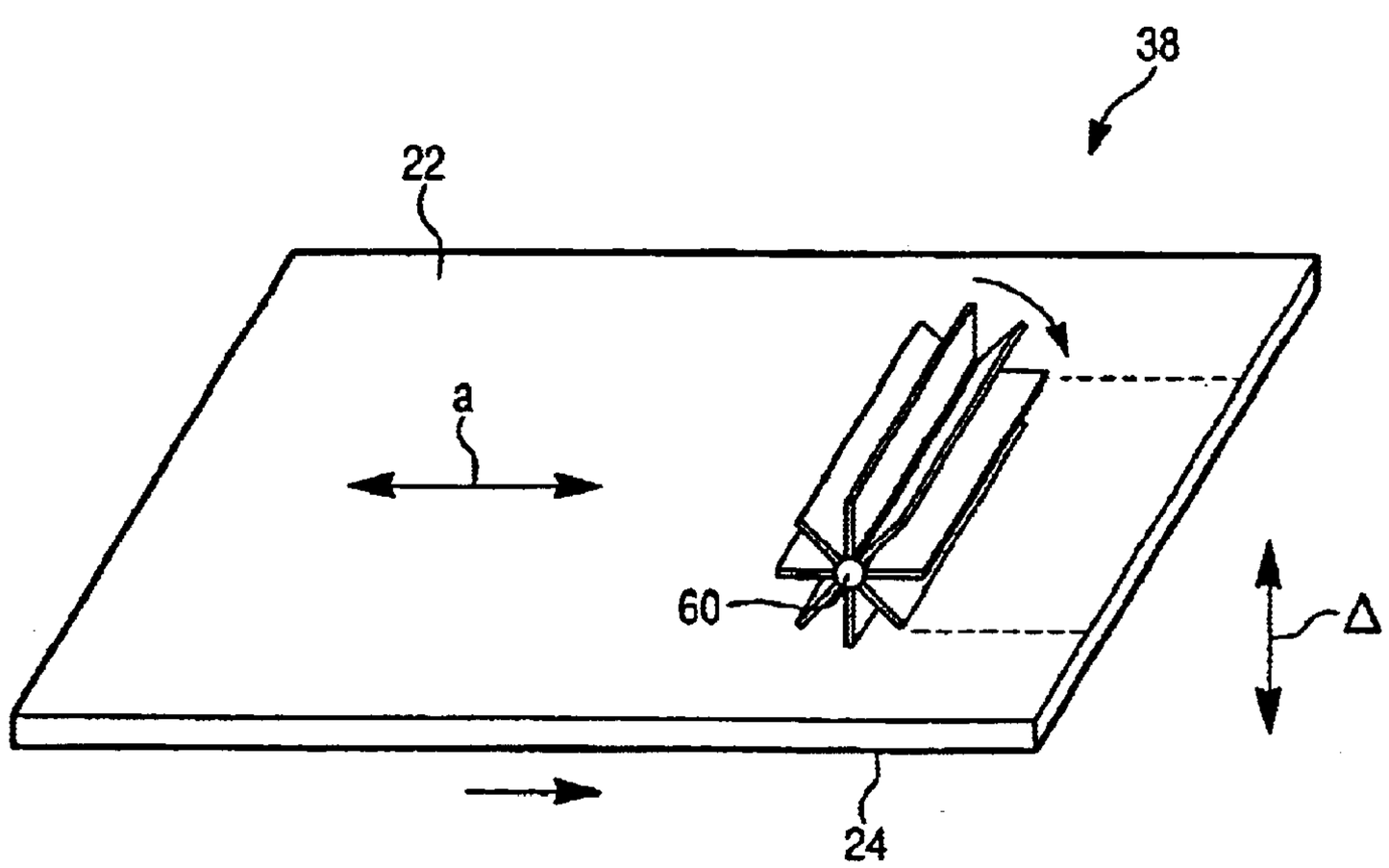


Fig. 5

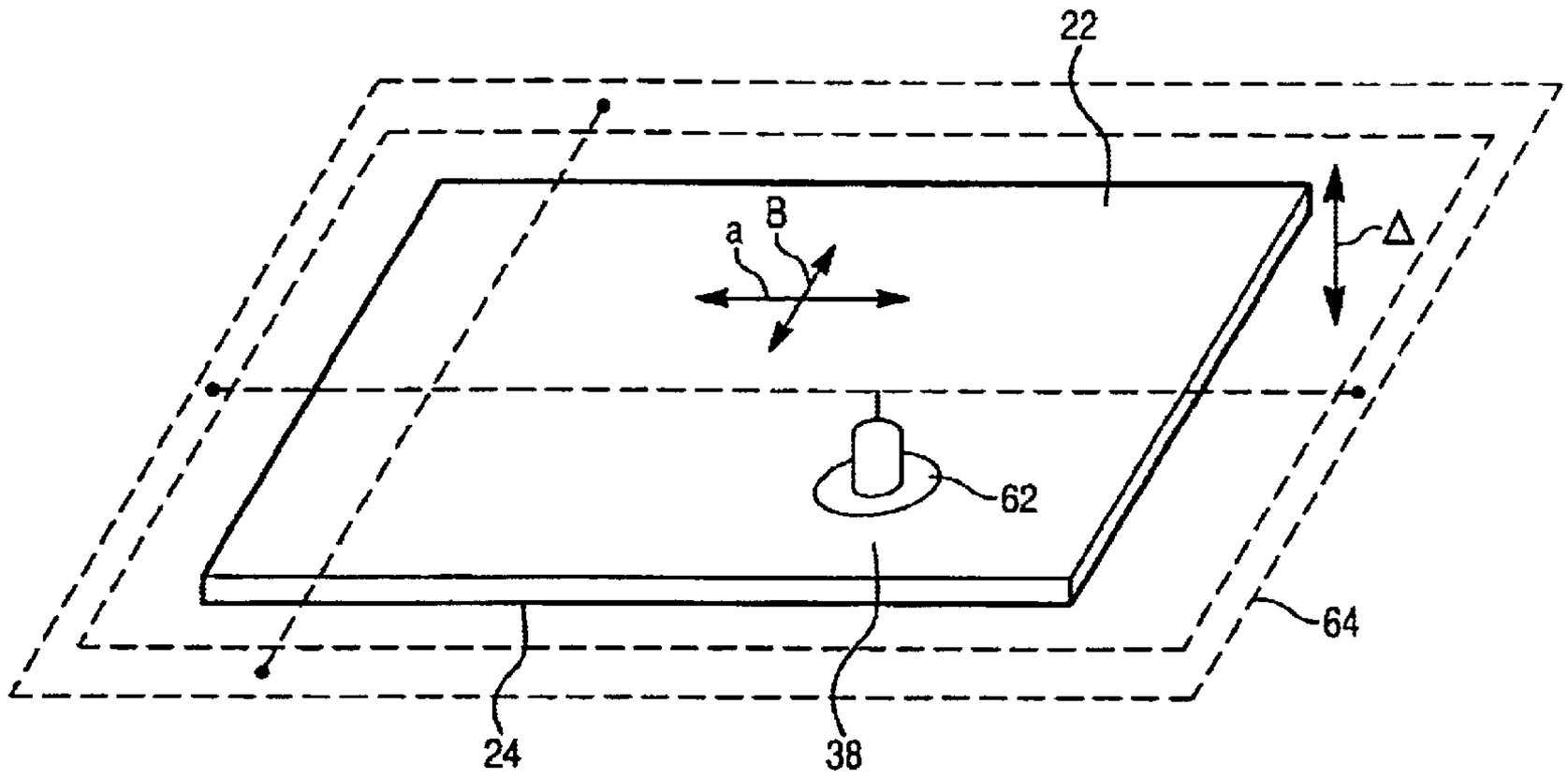


Fig. 6

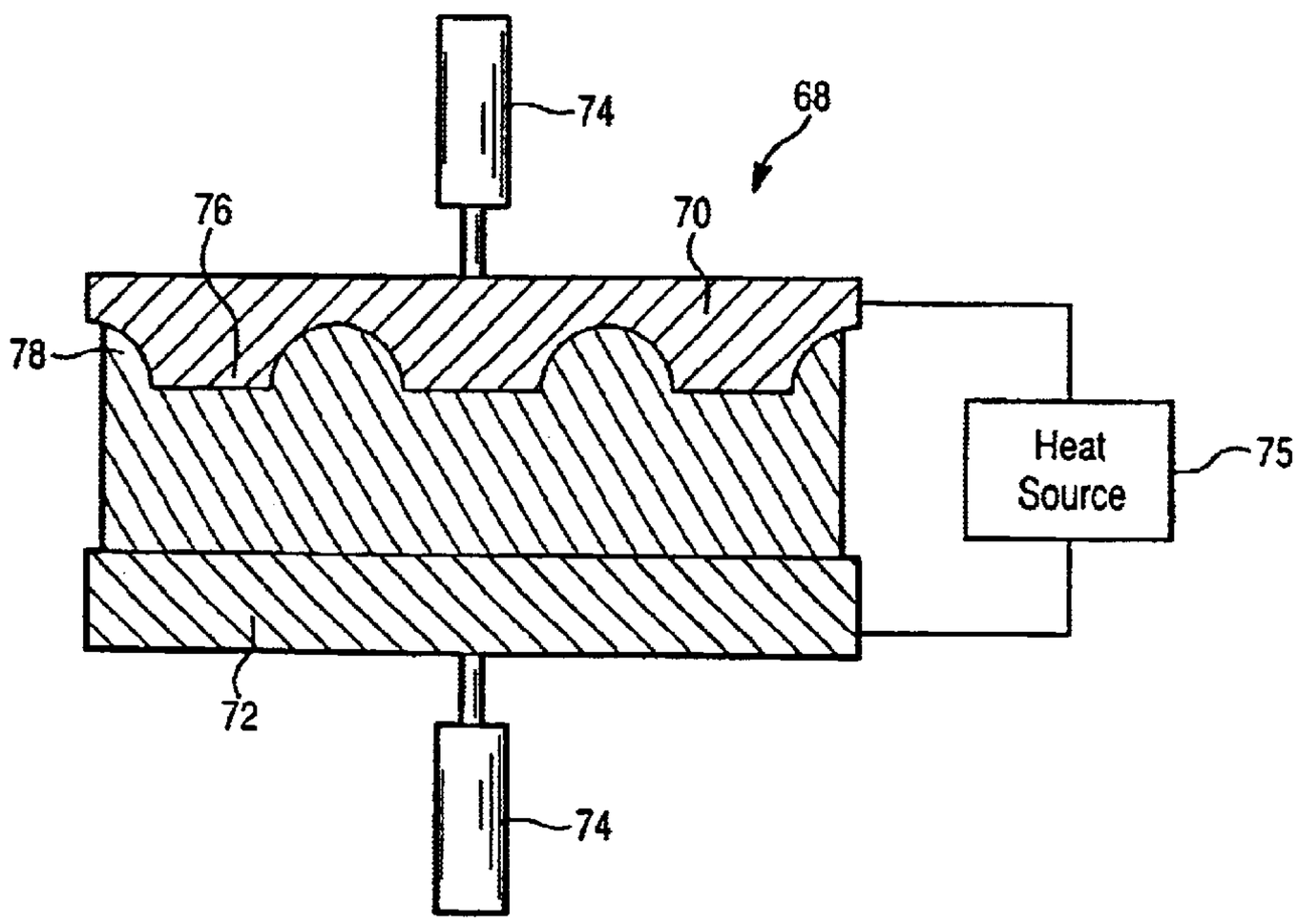
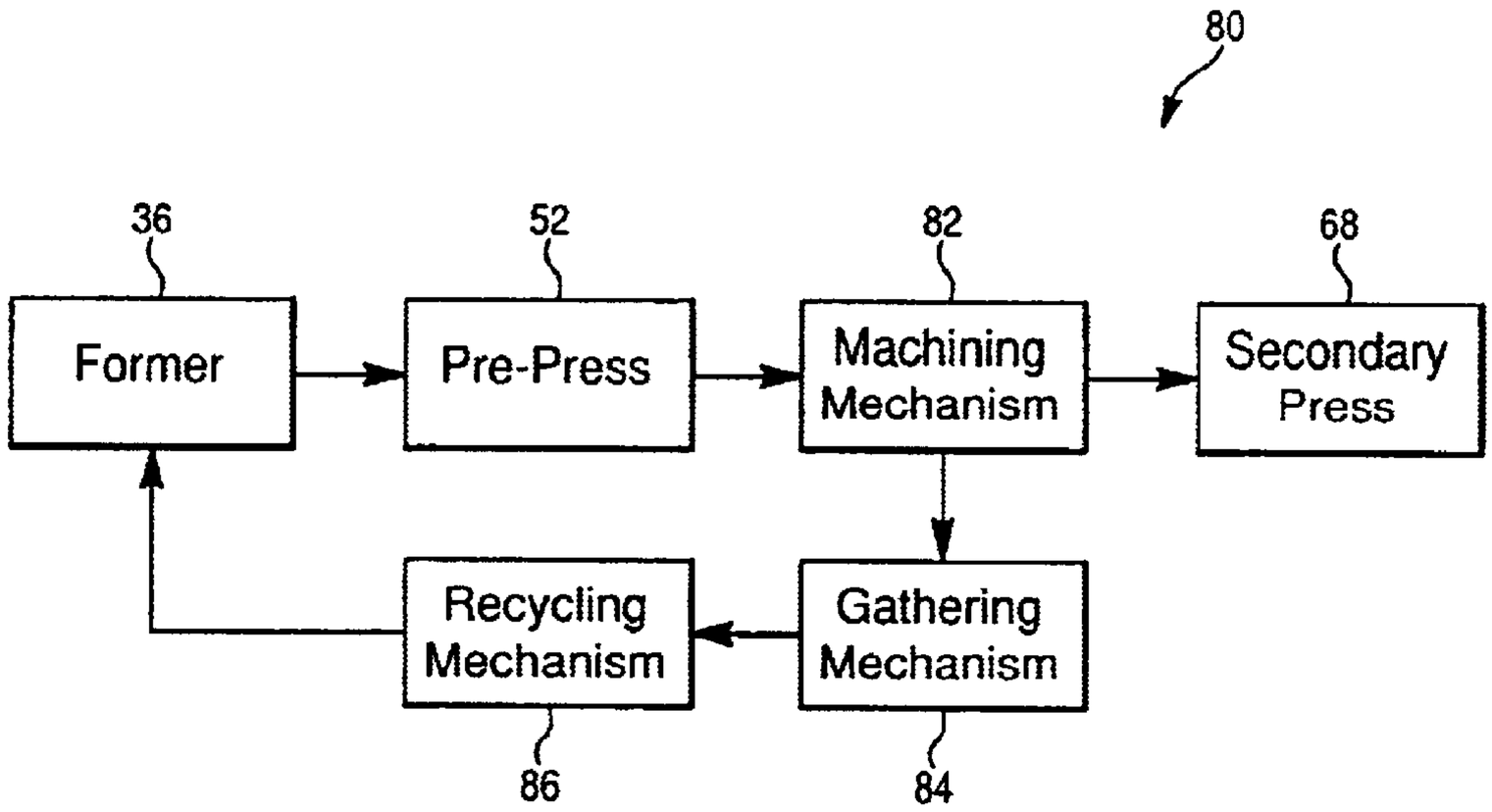


Fig. 7


80
36
52
82
68
Former
Pre-Press
Machining Mechanism
Secondary Press
Recycling Mechanism
Gathering Mechanism
86
84

METHOD OF MANUFACTURING CONTOURED CONSOLIDATED CELLULOSIC PANELS WITH VARIABLE BASIS WEIGHT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention generally relates to wood products and, more particularly, relates to methods of manufacturing consolidated cellulosic panels.

2. Description of Related Technology

Consolidated cellulosic panels, such as fiber board, paper board, particle board, and the like, are typically comprised of wood furnish such as saw dust, shavings, chips, or specially ground fibers, compressed with a binding agent or resin under heat and pressure. Such boards can be used in a variety of applications including, but not limited to, exterior house siding, interior and exterior door facing panels or door skins, cabinet doors, paneling, moulding, etc.

It is often desirable to manufacture such panels to a uniform basis weight and caliper. If the panels are flat this can be accomplished by compressing a mat between first and second flat faced dies. However, if one of the faces needs to be deeply contoured, such die compressions have proven to be problematic. For example, if a first die has a contour corresponding to the desired shape of the panel, and the second die has a flat face, the mat compressed therebetween will have a non-uniform caliper, with the thinner areas of the mat being compressed to a higher density than thicker areas. This is especially true with fiberous materials that do not flow under pressure.

Current methods of producing such panels therefore typically require that a mat having first and second opposed flat surfaces be compressed according to conventional methods, and that one or more of the surfaces then be machined to have the desired contour. For example, a router may be used to shape the surfaces. U.S. Pat. No. 4,175,106, assigned to the present assignee, discloses such a process. Such tools, however, cannot easily produce sharp inside corners, are relatively slow, and require complex, expensive equipment.

Another method requires contoured, complementary, dies on both the top and bottom to produce a substantially uniform thickness through the contoured and non-contoured areas. If one of the top or bottom needs to be flat, or alternatively shaped, the panel must undergo an added machining step adding time, expense and waste to the operation. Shallow contouring of one face is typically done in an embossing operation, or with an embossing die, but the depth of embossing is greatly limited.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention, a method of manufacturing a contoured, consolidated cellulosic article having a variable basis weight is provided. The method comprises the steps of forming a loose mat of cellulosic material and a binder resin, the mat having a top surface and a bottom surface, machining at least one of the top surface and bottom surfaces to have a pattern, and consolidating the mat between a top platen and a bottom platen. The top and bottom platens have contours complementary to the patterns machined into the mat top and bottom surfaces, respectively.

In accordance with another aspect of the invention, a method of manufacturing a consolidated cellulosic article is provided comprising the steps of depositing cellulosic fiber and a binding agent onto a moving conveyor to form a mat, applying suction through the conveyor belt, scalping a top surface of the mat, compressing the mat between upper and lower platens at a first pressure, machining a pattern into the top surface by removing cellulosic material in a desired pattern, gathering the removed cellulosic material, and compressing the mat between third and fourth platens. The conveyor is perforated so as to enable the suction to hold the mat onto the belt. The scalping step creates a mat of uniform height. The third and fourth platens are contoured complimentarily to contours of the top and bottom surfaces, respectively.

In accordance with another aspect of the invention, a method of manufacturing a contoured, consolidated cellulosic article with variable basis weight is provided, which comprises the steps of forming a loose mat of cellulosic material and a binder resin, the mat having a top surface and a bottom surface, prepressing the loose mat to a first density and caliper, machining at least one of the top surface and bottom surface to have a pattern, and consolidating the mat between a top platen and a bottom platen. The top and bottom platens have contours complementary to the pattern machined into the mat top and bottom surface, respectively. The consolidating step compresses the mat to a second density and caliper. The second density is greater than the first density.

These and other aspects and features of the invention will become more apparent upon reading the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of an article constructed in accordance with the teachings of the invention;

FIG. **2** is a schematic representation of a mat being preliminarily formed according to the teachings of the invention;

FIG. **3** is a partial sectional view of a mat being prepressed according to the teachings of the invention;

FIG. **4** is a schematic representation of a mat being machined in two dimensions according to the teachings of the invention;

FIG. **5** is a schematic representation of a mat being machined in three dimensions according to the teachings of the invention;

FIG. **6** is a partial sectional view of a mat being compressed under heat and pressure according to the teachings of the invention; and

FIG. **7** is a schematic representation of a system constructed in accordance with the teachings of the invention.

While the invention is susceptible to various modifications and alternative constructions, certain illustrative embodiments thereof have been shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and with specific reference to FIG. **1**, an article constructed in accordance with the teachings of the invention is generally referred to by refer-

ence numeral **20**. While the article **20** is depicted as a six panel door facing, it is to be understood that the teachings of the invention can be employed in the construction of any number of other consolidated cellulosic articles having a contoured surfaces such as, but not limited to, exterior house siding, interior and exterior door facing panels or door skins, cabinet doors, paneling, and moulding.

As shown in FIG. **1**, the article **20** includes a first or top surface **22**, a second or bottom surface **24**, first and second side edges **26**, **28**, and first and second end edges **30**, **32**. The top surface **22** is contoured, whereas the bottom surface **24** is flat or planar in the depicted embodiment. More specifically, the top surface **22** includes a plurality of indentations **34** of various dimension and depth to provide an appearance desirable for the end application of the article **20**. In the depicted embodiment, the bottom surface **24** is flat to facilitate attachment of the article **20** to a door core, but it is to be understood that the article **20** may include a back surface having a non-flat contour as well.

Referring now to FIG. **2**, a former **36** according to the teachings of the invention is depicted generating a mat **38**. The former **36** includes a hopper **40** from which a combination of cellulosic fibers and a binding agent or resin are deposited onto a moving conveyor belt **42**. The binding agent may be any number of different known agents including, but not limited to, phenolic resin or isocyanate. The conveyor belt **42** is preferably perforated, with a suction device **44** being proximate the conveyor belt **42**. The suction device **44** generates a pressure differential across the conveyor belt **42** thereby holding the mat **38** to the conveyor belt **42**.

As can be seen in FIG. **2**, the cellulosic material is deposited upon the conveyor belt **42** at an inconsistent height (exaggerated in FIG. **2** for the purpose of illustration). Accordingly, downstream of the hopper **40** a rotary scalper **46** may be provided. The scalper **46** includes a rotating axle **48** from which a plurality of blades **50** radially extend. Rotation of the scalper **46** causes the blades **50** to engage the mat **38** and thereby reduce the mat **38** to a consistent thickness. It is to be understood that the scalper **46** may be provided in alternative forms, such as saw blades, for removal of the cellulosic material.

Referring now to FIG. **3**, a pre-press **52** according to the teachings of the invention is depicted. The pre-press **52** includes a first platen **54** as well as a second platen **56** which are adapted to be compressed together as by hydraulic cylinders **58**. The pre-press **52** compresses the mat **38** to a softboard **53**, defined herein as a compressed mat of cellulosic fiber and a binding agent having a relatively low density, e.g., 10 to 30 lbs. per cubic foot. Such a softboard has sufficient density and strength to maintain its shape, as opposed to being a loose pile of fibers, but would not be suitable for use as a solid product such as siding or doors. The softboard **53** is preferably formed in the absence of heat or moisture so as to avoid curing of the binding agent and thereby allow for the material removed, as by the rotary scalper **46**, to be recycled.

Once the softboard **53** is formed, it is machined as shown in FIGS. **4** and **5**, resulting in a softboard **53** having a variable basis weight across its dimension. For example, as shown in FIG. **4**, the top surface **22** of the softboard **53** may be machined along a single axis, e.g., a longitudinal axis a, to provide a contoured top surface **22** while maintaining the bottom surface **24** in a planar configuration. If the softboard **53** is machined as depicted in FIG. **4**, wherein a second rotary scalper **60** removes material along the longitudinal axis ∝, (as well as a depth axis Δ) material such as house siding can be easily manufactured. If the end product needs to be machined along the longitudinal and lateral axes α and β (as well as along the depth axis Δ) as with a six panel door as depicted in FIG. **1**, a router **62** may be employed as shown in FIG. **5**. The router **62** is preferably mounted on a track system **64** and connected to a CNC control (Computer Numerical Control) or the like for movement of the router **62** in appropriate directions.

Referring now to FIG. **6**, a secondary press **68** according to the teachings of the invention is shown in partial sectional view. The secondary press **68** preferably includes an upper platen **70**, a lower platen **72** and a mechanism for compressing the upper and lower platens **70** and **72** together. Such a mechanism may be provided in the form of hydraulic cylinders **74**, but may be provided in any other type of actuator including, but not limited to, pneumatic cylinders, motors, and the like.

In the depicted embodiment, the upper platen **70** includes a plurality of protrusions **76** such that the contour of the upper platen **70** is complimentarily shaped to a pattern **78** form in the upper or top surface **22** of the softboard **53**. Also in the depicted embodiment, the lower platen **72** is flat or planar so as to match the planar shape of the bottom surface **24**, but it is to be understood that if the bottom surface **24** is otherwise contoured, the lower platen **72** would be shaped to correspond to the contour of the bottom surface **24**.

The secondary press **68** preferably has a heat source **75** associated therewith to compress the softboard **53** under heat and pressure. The heat source **75** may be provided in the form of heat exchanger coils or channels through the platens **70**, **72**, through which heated fluid, e.g., water, is circulated, or in the form of separate hot platens.

Referring now to FIG. **7**, a system **80** according to the teachings of the invention is shown in schematic fashion. As shown therein, the system **80** includes the former **36**, the pre-press **52**, a machining mechanism **82**, the secondary press **68**, as well as a gathering mechanism **84** and a recycling mechanism **86**.

The machining mechanism **82** may be provided in the form of the aforementioned rotary scalper **60** or router **62**, but can alternatively be provided in the form of any other type of mechanism for removing cellulosic material from the mat **38** including, but not limited to, circular saw blades, band saw blades, sanders, and the like. The gathering mechanism **84** may be provided in the form of a conveyor provided below the machining mechanism **82**, or may be provided in the form of a vacuum device for drawing the removed cellulosic material away. The recycling mechanism **86** preferably communicates the material gathered by mechanism **84** back to the former **36** for use in the formation of subsequent articles **20**. Accordingly, the recycling mechanism **86** may include conveyors, suction lines, or the like.

From the foregoing, it will be appreciated that the teachings of the invention may be employed to manufacture a contoured, consolidated cellulosic article having variable basis weight.

What is claimed is:

1. A method of manufacturing a contoured, consolidated cellulosic article, having a variable basis weight, comprising the steps of:

forming a loose mat of cellulosic material and a binder resin;

trimming the mat to a preslected height by scalping the upper portion of the mat with a first rotary scalper;

creating a softboard by pre-pressing the mat at a first pressure between first and second platens, the softboard

having a top and a bottom surface and being formed in the absence of heat to avoid curing of the binder resin;

machining at least one of the top and bottom surfaces to have a pattern; and

consolidating the mat between a third platen and a fourth platen at a second pressure that is greater than the first pressure, the third and fourth platens having contours complementary to contours in the mat top surface and bottom surface, respectively.

2. The method of claim **1**, wherein the forming step is performed by sprinkling cellulosic fiber and a binder resin onto a moving conveyor belt.

3. The method of claim **2**, further including the step of applying suction through the conveyor belt to hold the mat to the belt and ensure that the mat is trimmed to a preselected height, the suction is applied during the forming step and prior to the trimming step.

4. The method of claim **1**, wherein the softboard has a density within the range of about 10 to about 30 pounds per cubic foot.

5. The method of claim **1** wherein the machining step is performed along one of a longitudinal and lateral axis of the mat.

6. The method of claim **1** , wherein the machining step is performed along both a longitudinal and lateral axis of the mat.

7. The method of claim **5**, wherein the machining step is performed using a second rotary scalper.

8. The method of claim **6**, wherein the machining step is performed using a computer numerically controlled router.

9. The method of claim **1**, wherein the consolidating step is performed under heat and pressure.

10. The method of claim **1**, further including the steps of gathering the cellulosic material during the machining step, and reusing the gathered cellulosic material in subsequent iterations of the forming step.

11. A method of manufacturing a consolidated cellulosic article, comprising the steps of:

depositing cellulosic fiber and a binding agent onto a moving conveyor belt to form a mat, the conveyor belt being perforated;

applying suction through the conveyor belt, the applied suction holding the mat to the belt;

scalping a top surface of the mat, the scalping step creating a mat of uniform height;

pressing the mat between upper and lower platens at a first pressure to form a softboard, the softboard being formed in the absence of heat to avoid curing of the binder resin;

machining a pattern into the top surface by removing cellulosic material in a desired pattern;

gathering the removed cellulosic material; and

compressing the mat between third and fourth platens, the third and fourth platens having contours complementary to a top and bottom surface of the mat, respectively.

12. The method of claim **11**, wherein after the pressing step the mat has a density within the range of about 10 to about 30 pounds per cubic foot.

13. The method of claim **11**, wherein the machining step is performed along one of a longitudinal and lateral axis of the mat.

14. The method of claim **13**, wherein the scalping step is performed by a first rotary scalper and the machining step is performed using a second rotary scalper.

15. The method of claim **11**, wherein the machining step is performed along both a longitudinal and a lateral axis of the mat.

16. The method of claim **15**, wherein the machining step is performed using a computer numerically controlled router.

17. The method of claim **11**, wherein the compressing step is performed using a computer numerically controlled router.

18. The method of claim **11**, further including the step of reusing the removed cellulosic material in subsequent iterations of the depositing step.

19. A method of manufacturing a compressed cellulosic product having a three dimensional surface and a variable weight basis, the method comprising:

depositing unconsolidated cellulosic material and a binder resin on a moving conveyor belt, the conveyor bolt being connected to a suction device so that the unconsolidated cellulosic material and binder resin are securely affixed to the conveyor belt and thereby form mat on the surface of the conveyor belt;

scalping the upper portion of the mat with a first rotary scalper so that the mat has a uniform preselected caliper;

pressing the mat between first and second platens at a pressure sufficient to form a softboard having a density between 10 and 30 pounds per cubic feet, the softboard being formed in the absence of heat to avoid curing of the binder resin;

machining the softboard with a second rotary scalper to contour the surface of the softboard and thereby establish a variable weight basis;

pressing the softboard between third and fourth platens in a presence of heat and a pressure, the pressure being greater than the first mentioned pressure, the third and fourth platens having contours corresponding to the machined surface of the softboard, and thereby forming a cellulosic product having a density greater than the density of the softboard.

* * * * *